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**THE IMPACT OF ANTIOXIDANT AND ANTI-BACTERIAL PROPERTIES OF
CINNAMON ON CHOCOLATE CAKE BATTER USING MICROBIAL EXPERIMENT**

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ABSTRACT

Cake is one of baking products having a porous tissue, tiny holes with thick walls and spongy form. It is one of the confectionery products with different types of calorie. In the current research, the impact of adding cinnamon(in amount of 1 and 3%) and surbathe on physical ,chemical, sensory features, some rheological (farinograph and exteniograph) and microbial properties of chocolate cakes was studied. Microbial tests were performed on wheat flour, cocoa powder, and cinnamon so that finally microbial tests were done on all treatments based on standard methods. The results showed that farinography features such as water absorption and loosening degree of batter containing cinnamon were more than of control sample, and treatment B has the highest level of farinography features than other treatments. Also results of extensography test performed on batter samples showed that extensography features such as amount of energy and tensile, tensile strength and maximum strength, and maximum strength and ratio number are highest in treatments D, C, and B, respectively. In terms of results of organoleptic features, samples containing cinnamon have higher points in smell and taste. The results of microbial test indicated that treatments C (with cinnamon) and D (with surbathe) have the lowest microorganism level. Also, treatment B (1% cinnamon) was identified as the best treatment in all tests.

Keywords: Cinnamon- Surbathe- Rheological Features- Microbial- Qualitative Features- Chocolate Cake

INTRODUCTION

Cake is one type of cookies with European originality. It has several meanings in English language; also a little and flat piece of baked batter is called 'cake'. Accordingly, archaeologists state that this type of food had existed from ancient times, but the imagination of cake existing today with three features of sweetness, light, and spongy tissue refers to middle of 18th century.

Bread is the origin of cake so history of cake and bread are interwoven. The most important factor for separation of bread from English cake is removing yeast from bread. In 1727, the order of a cake is shown in cooking book that just uses egg puffing the cake. At that time, it was realized that using too much eggs in cake would remove the need to yeast. In 1780, microwave ovens were produced and it was possible to bake lighter cakes.

In the beginning of 19th century, a new type of cake was common known as 'pound cake'; all materials of this cake weighted one pound (453 g), and 8 eggs were used for their equality with others in weight. The latest development in making cakes like modern ones was use of chemical puffing materials. In 1790s, use of such materials begun called 'potassium carbonate'. In 1840s, baking soda (bicarbonate) was produced; this type of chemical materials that acted quicker than

yeasts made time of baking bread and cake shorter than before, and in 1850 baking powder was invented that using it caused spongy, light, and soft tissue of cakes; so modern cakes emerged. During recent years, cake industry has developed rapidly all around the world. Till now many research has conducted about change and adjustment of cake ingredients since it provides a strong tool for manufactures in order to quality improvement and increase in product durability.

Cinnamon chocolate cake is a combination of flour, oil, egg, sugar, and salt with added cocoa and cinnamon. Cinnamon contains several anti-microbial antioxidants. Most of antioxidants are anticancer; they are often added to foods to prevent radical oxidation chain reactions leading to delay in oxidation process. However, artificial antioxidants often used such as butaltide hydroxi anisole (BHA) and butaltide hydroxi toluene (BHT) are banned by laws and regulations because of doubt about their toxic and carcinogenic effects. Therefore, there is a great interest in food applications to replace natural antioxidants instead of artificial ones; also there is an improvement in customers preferring natural antioxidants that provide more motivation to discover natural antioxidants resources.

Since ancient times, plants and spices were added to several types of foods tasting the food and improving durability of food storage. Help of plants and spices transform antioxidant effects to active parts of food called 'phenolics'. Lauraceae is an important economic species forming most of trees and plants. Cinnamon includes about 250 pieces distributed in Asia and Australia. In south of India, these trees grow to the height of 500 meters; but they are often seen at height below 200 meters. Hexane extracted from cinnamon bark and cinnamon oil has antioxidant activity.

Cinnamon is symbol of youth and its daily use keeps human young and healthy. It is also used to increase and recover sexuality; it warms the kidneys, removes backache and foot pain, and cures anemia. Cinnamon is the best medicine for muscular pains. The other important effect of cinnamon is fever lowering; even nowadays it is made in form of tablets and capsules serving as febrifuge.

History of cake

Cake is one of baking products having a porous tissue, tiny holes with thick walls and spongy form. Making this situation, the main role is on behalf of gluten though starch also plays a role in process stability. Cake is one of confectionery products having several types with different calories; high calorie of cakes is usually due to oil, egg, and sugar used in their formulation. According to standard No.2553 of Iran, cake refers to a type of cookie with a soft fiber including oil, flour, sugar, and egg. Although archaeologists believe that this type of food has existed long ago, but the imagination of cake existing today with three features of sweetness, light, and spongy tissue refers to middle of 18th century.

MATERIALS AND METHODS

Features of laboratory supplies used in this research are explained in the **Table 1** below:

Table (1) features of laboratory supplies used in research

manufacturer/country	materials
Novin Petro Pars/Iran	Propionate Calcium
Merck/Germany	citric acid
Merck/Germany	Acetic Acid
Merck/Germany	Potassium Sulphate
Merck/Germany	Sulfuric Acid
Merck/Germany	Selenium Di Oxide
Merck/Germany	Sodium Sulphate
Merck/Germany	Lactic Acid

Merck/Germany	Etro De Petrol
Merck/Germany	Iso Propanol
Merck/Germany	Bromo fenol
Merck/Germany	Natrium Phodspate
Merck/Germany	Calium Bi Phosphate

Table (2) introduction of treatments used in research

Code	Descriptions	Row
A	chocolate cake containing wheat flour and 1% xanthan gum, without cinnamon and surbathe	1
B	chocolate cake containing wheat flour and 1% of cinnamon and 1% xanthan gum, without surbathe	2
C	chocolate cake containing wheat flour and 3% of cinnamon and 1% xanthan gum, without surbathe	3
D	chocolate cake containing wheat flour, surbathe and 1% xanthan gum, without cinnamon	4

Table (3) chocolate cake microbial tests

reference	method	test
(1993, unknown)	Iran national standard No. 2395	Antrobacteriace test
(1993, unknown)	Iran national standard No. 2395	Ashershia Kelly test
(1993, unknown)	Iran national standard No. 2395	Salmonella test
(1993, unknown)	Iran national standard No. 2395	Acetafilo cocoas oueros co-agulaze test
(1993, unknown)	Iran national standard No. 2395	Bacillus cereous test
(1993, unknown)	Iran national standard No. 2395	mold & yeasts test
(1993, unknown)	Iran national standard No. 2395	Klifform test

Results of microbial tests of white flour, cocoa powder and cinnamon

Results of microbial tests conducted on white flour, cocoa powder and cinnamon are shown in the Table 4 below:

Table (4) Results of microbial tests of white flour, cocoa powder and cinnamon

SDA	Number of colonies in 4 plates (log cfu/ml)		Feature material
	YRB	TSA	
40-52-47-43	45-45-53-55	98-110-114-125	White flour
9-13-3-12	19-15-17-23	40-39-35-35	Cocoa powder
5-4-2-3	7-5-5-4	21-19-15-13	cinnamon

Table (5) descriptive statistic results of medium and raw materials (mean± standard deviation)

mean± SD	Raw materials	mean± SD	medium
68.917± 3.562	white flour	19.417± 3.562	SDA
21.667± 3.562	Cocoa powder	3.562± 55.333	TSA
8.583± 3.562	cinnamon	24.417± 3.562	VRB

Table (6) results of comparison between medium and raw materials

Number of colonies in 4 plates (log cfu/ml)	Raw materials	Number of colonies in 4 plates (log cfu/ml)	medium
68.916666	White flour	8.375	SDA
21.666666	Cocoa powder	7	TSA
8.583333	cinnamon	2.6875	VRB

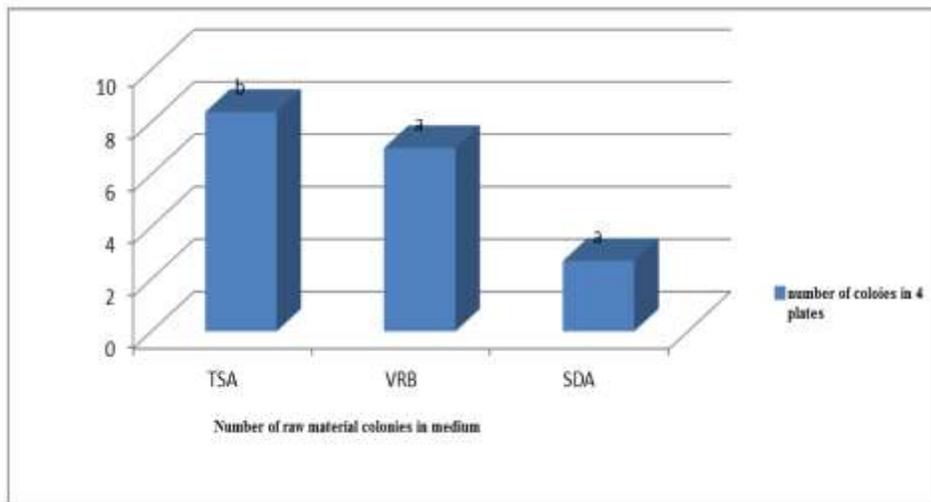


Figure (1) number of raw material colonies (white flour, cocoa powder and cinnamon) in medium

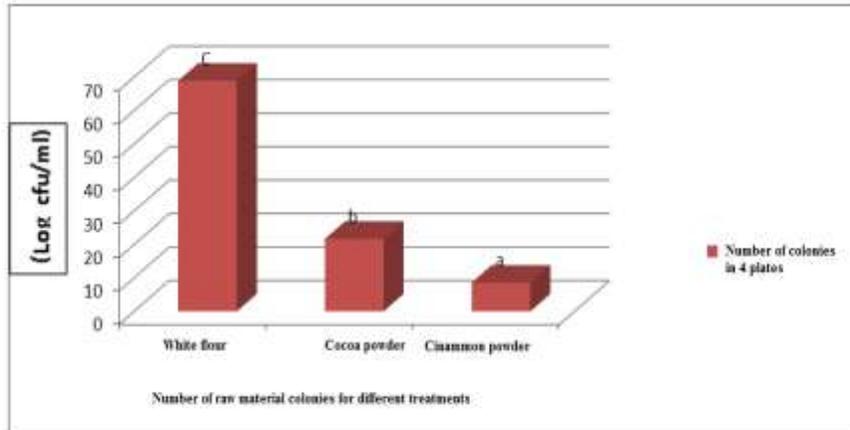


Figure (2) number of raw material colonies for different treatments

Microbial test results of chocolate cake batter

The results of comparison between microbial tests (batter corruption with Aspergillus,

Bacillus, Ashershia, and Acetafilo coce) and batter microbial load (in each treatment and medium) are shown in tables (7) and (8), respectively.

Table (7) comparison results of batter corruption with Asperzillous, Bacillus, Ashershia, and Acetafilo coce

Acetafilo cocos (log cfu/ml)	Ashershia (log cfu/ml)	Bacillus (log cfu/ml)	Asperzillous (log cfu/ml)	Type of germs Treatment
58	15	13	46	Without surbathe
58	15	13	0	With surbathe
3	2	5	6	Cinnamon 1%
0	0	0	0	Cinnamon 3%
42	39.5	30.75	28.25	Control group

Table (8) mean comparison results of batter microbial loads in treatments and mediums

Number of colonies in 4 plates (log cfu/ml)	Medium	Number of colonies in 4 plates (log fu/ml)	Treatment
8.375	TSA	13.41666	Without surbathe
7	VRB	6.91666	With surbathe
2.6875	SDA	2.666	Cinnamon 1%
		1.08333	Cinnamon 3%

Results of variance analysis and descriptive statistics (mean \pm SD) of microbial tests for chocolate cakes' batter are shown in tables (9) and (10), respectively.

Table (9) results of variance analysis of microbial tests for chocolate cakes

Mean squares (MS)				Degree of freedom (df)	Change reference
Acetafilo coce (log cfu/ml)	Ashershia (log cfu/ml)	Bacillus (log cfu/ml)	Asperzillous (log cfu/ml)		
6800.800**	**1611.400	**1046.850	**2360.050	5	Treatment
149.467	24.200	31.117	9.917	15	Error
-	-	-	-	20	Total

** meaningful difference in level of 1%

Table (10) results of descriptive statistics (mean \pm SD) of microbial tests for chocolate cakes' batter

Standard deviation	Mean	Type of germs
18.914	16.050 \pm 1.575	Asperzillous
11.811	12.35 \pm 2.789	Bacillus
15.097	14.30 \pm 2.460	Ashershia
28.571	32.20 \pm 6113	Acetafilo coce

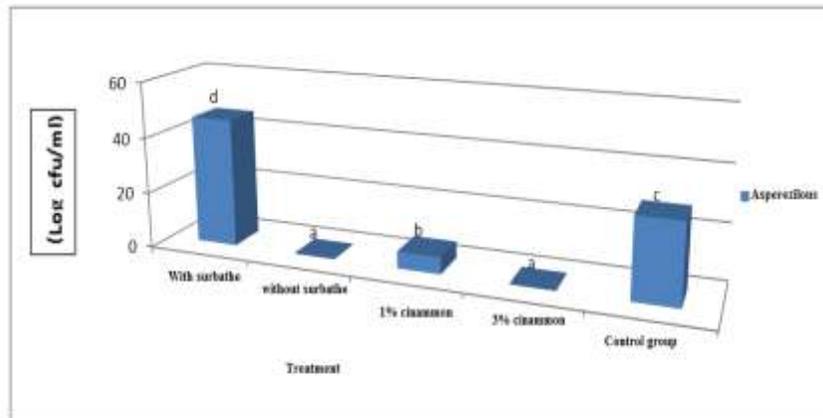


Figure (3) change in numbers of Aspergillus in chocolate cake samples containing different percents of cinnamon and surbathe

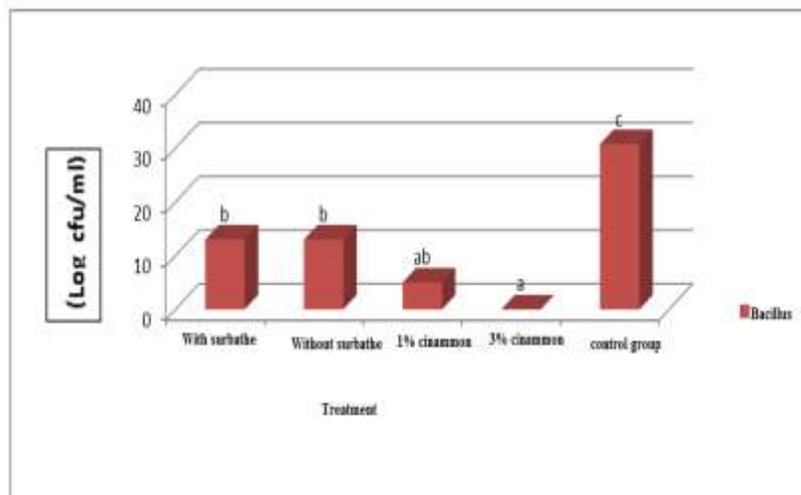


Figure (4) change in numbers of Bacillus in chocolate cake samples containing different percents of cinnamon and surbathe

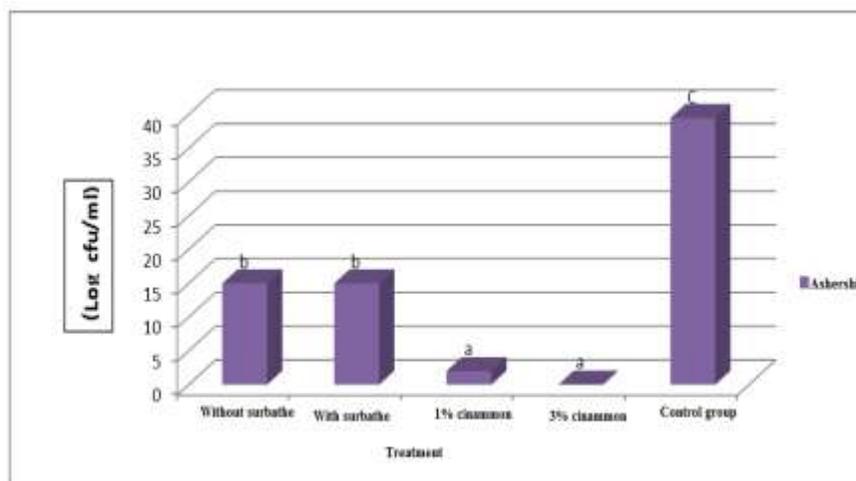


Figure (5) change in numbers of Ashershia in chocolate cake samples containing different percents of cinnamon and surbathe

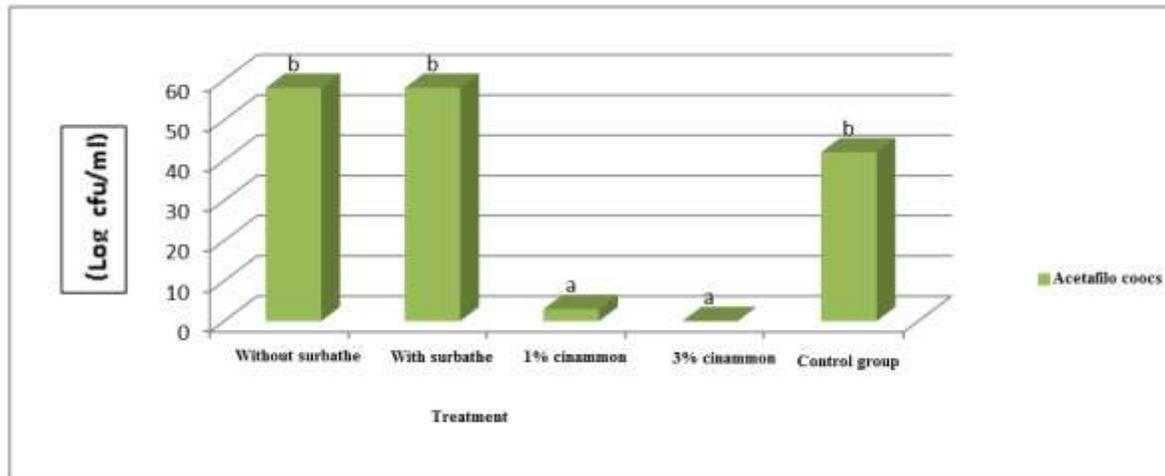


Figure (6) change in numbers of Acetabulo coecs in chocolate cake samples containing different percents of cinnamon and surbathe

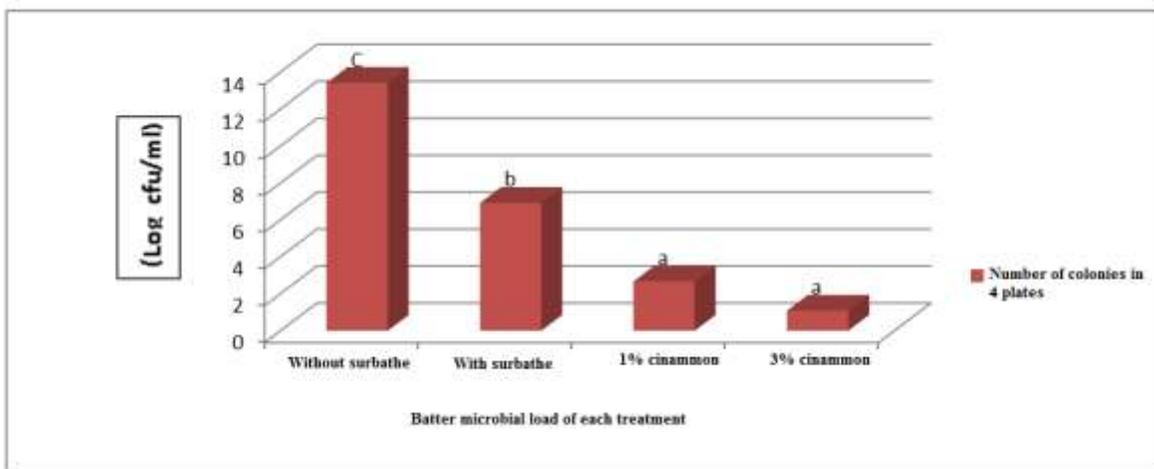


Figure (7) changes of chocolate cake batter's microbial load in each treatment

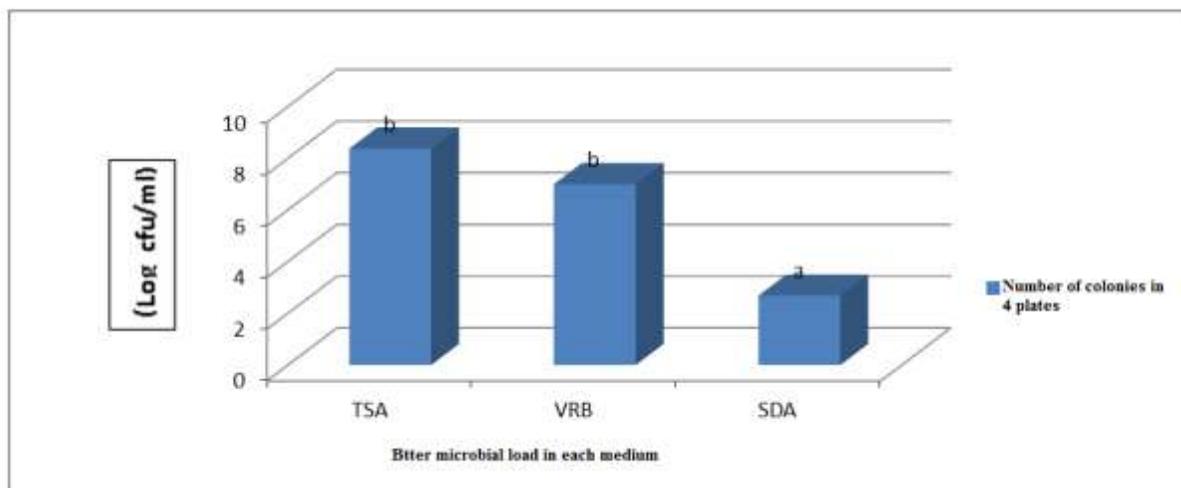


Figure (8) changes of chocolate cake batter's microbial load in each medium

Microbial test results of chocolate cake samples

Asperezilous) are shown in tables (11), (12), and (13), respectively.

Results of variance analysis, descriptive statistics (mean± SD), and mean comparison of microbial tests (points infected by

Table (11) variance analysis results of chocolate cake microbial test

Mean squares (MS)	Degree of freedom (df)	Change reference
Points infected by Asperezilous (log cfu/ml)		
*9.750	4	Treatment
1.750	8	Error
-	12	Total

* meaningful difference in level of 5%

Table (12) descriptive statistics results (mean± SD) of chocolate cake microbial test (points infected by Asperezilous)

SD	Mean	Germs
1.765	1.25± 0.764	Points infected by Asperezilous

Table (13) comparison of microbial test results of chocolate cakes (points infected by Asperezilous)

Corruption of product by pints infected to Asperezilous (log cfu/ml)	Feature Treatment
3	Without surbathe (A)
2	1% cinnamon(B)
0	3% cinnamon (C)
0	With surbathe (D)

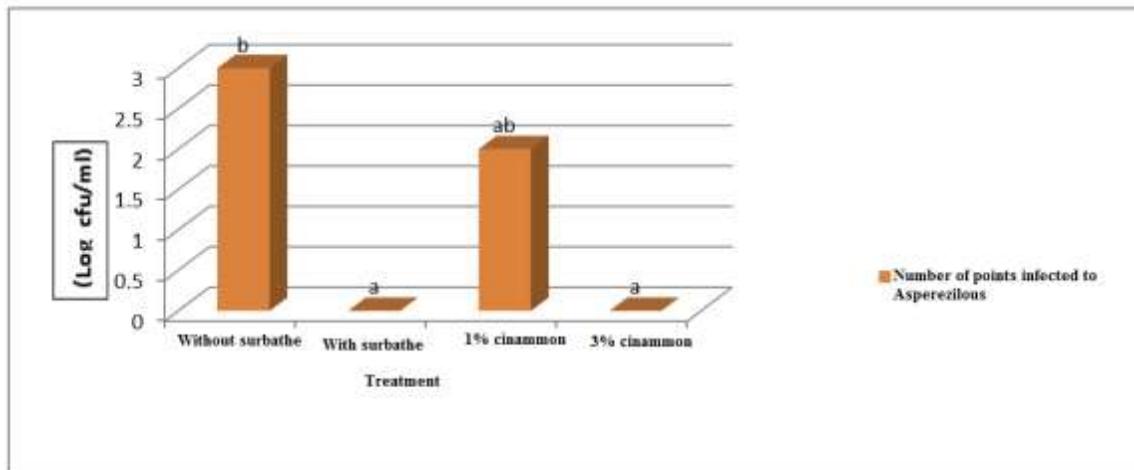


Figure (9) changes of chocolate cake points infected to Asperezilous

Results of variance analysis, descriptive statistics (mean± SD), and mean comparison of microbial tests (spread of Aspergillus in chocolate cakes) are shown in tables (14), (15), and (16), respectively.

Table (14) results of variance analysis (spread of Aspergillus) in chocolate cakes

Mean squares (MS)	Degree of freedom (df)	Change reference
Points infected to Aspergillus		
**8.750	4	Treatment
2.000	8	Error
-	12	Total

* meaningful difference in level of 1%

Table (15) descriptive statistics' results of microbial tests (spread of Aspergillus) in chocolate cakes

SD	Mean	Germs
4.434	3.25± 0.816	Spread of Aspergillus in chocolate cakes

Table (16) comparison results of microbial tests (spread of Aspergillus) in chocolate cakes

Spread of Aspergillus in chocolate cakes	Feature Treatment
10	Without surbathe (A)
3	1% cinnamon(B)
0	3% cinnamon (C)
0	With surbathe (D)

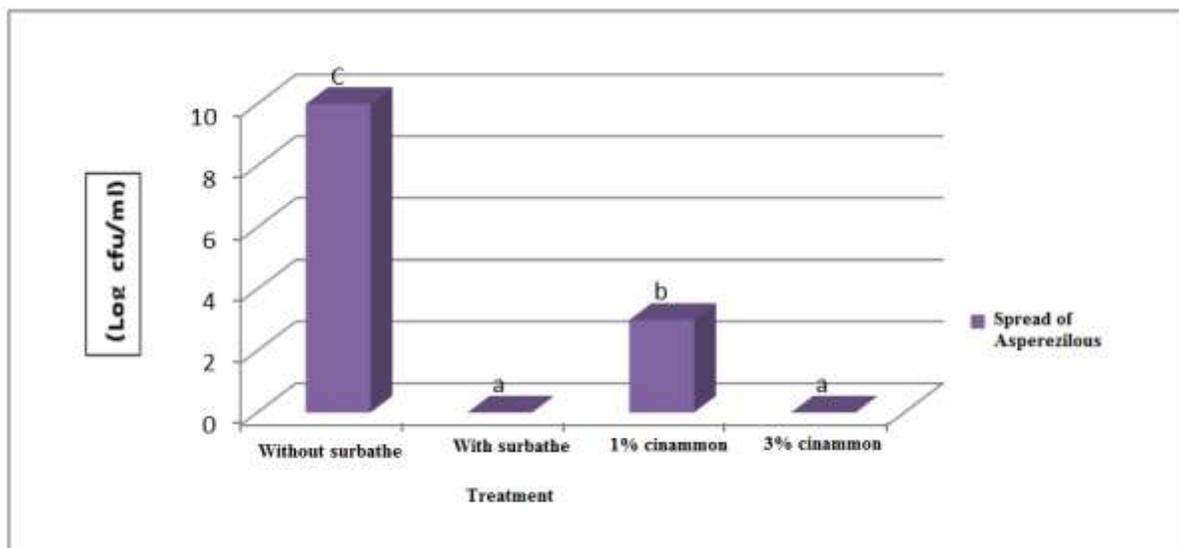


Figure (10) changes of Aspergillus expansion in chocolate cake samples

Results of variance analysis, descriptive statistics (mean± SD), and mean comparison of microbial tests (points infected by *Penisilium*) are shown in tables (17), (18), and (19), respectively.

Table (17) results of variance analysis in chocolate cakes

Mean squares (MS)	Degree of freedom (dg)	Change reference
Corruption of chocolate cakes with points infected to <i>Penisilium</i>		
*1.500	4	Treatment
500		8 Error
-		12 Total

* meaningful difference at level of 5%

Table (18) descriptive results of microbial tests

SD	Mean	Germ
0.798	0.50±0.408	Corruption of chocolate cakes with points infected to <i>Penisilium</i>

Table (19) comparison results of microbial tests

Corruption of chocolate cakes with points infected to <i>Penisilium</i>	Feature
	Treatment
1	Without surbathe (A)
13	1% cinnamon(B)
0	3% cinnamon (C)
0	With surbathe (D)

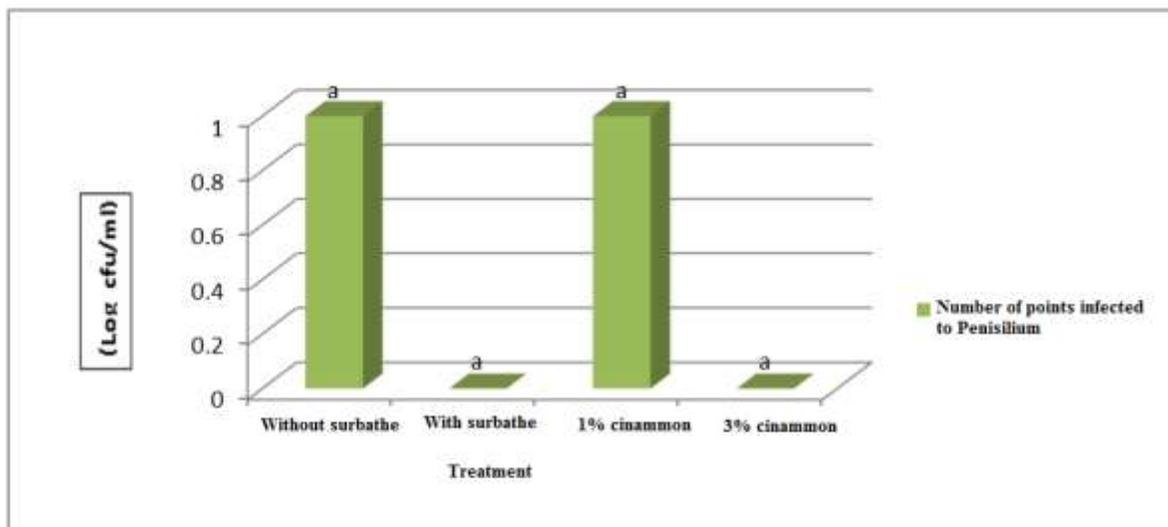


Figure (11) changes of points infected to *Penisilium* in samples of chocolate cake batter Table (20) variance analysis results of microbial testes (spread of *Penisilium* in chocolate cakes)

Mean squares (MS)	Degree of freedom (dg)	Change reference
Spread of Penicilium		
**68.417	4	Treatment
1.167	8	Error
-	12	Total

*meaningful at level of 1%

Table (21) descriptive statistics results of microbial tests (spread of Penicilium in chocolate cakes)

SD	Mean	Germs spread of Penicilium in chocolate cakes
3.769	3.25±0.624	

Table (22) Mean comparison results of microbial tests

spread of Penicilium in chocolate cakes	Feature Treatment
8.3333	Without surbathe (A)
4.6666	1% cinnamon(B)
0	3% cinnamon (C)
0	With surbathe (D)

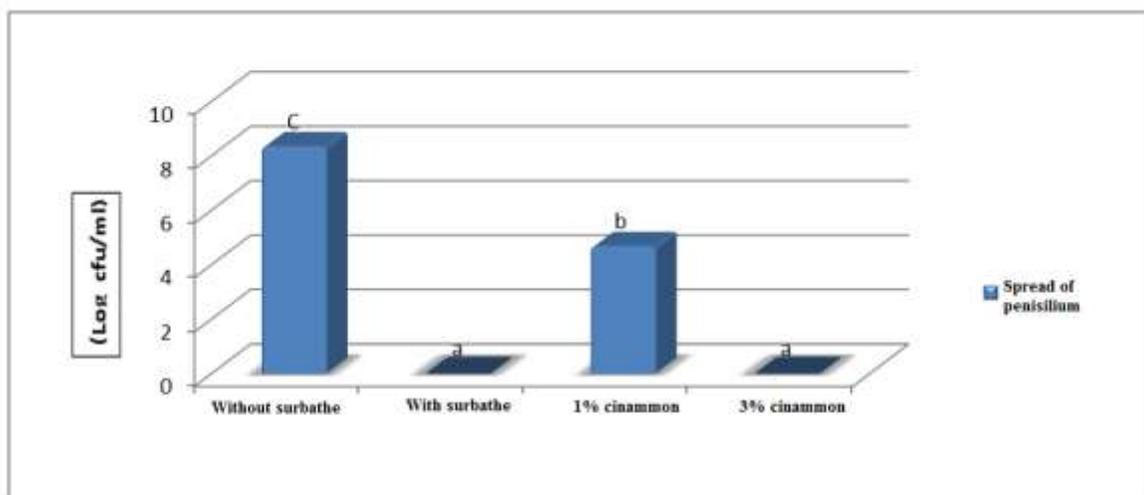


Figure (21) changes of Penicilium expansion in chocolate cake samples

CONCLUSIONS

Microbial evaluation of test results for chocolate cake raw materials

Number of raw material colonies in medium SDA, VRB, TSA

According to mean comparison results of raw material colonies in medium, the most and least number of colonies are observed in TSA and SDA mediums, respectively.

Impact of adding several levels of cinnamon (1 and 3 %) and surbathe on *Aspergillus niger* corruption in batter

According to the results, it is observed that use of cinnamon instead of wheat flour would decrease *Aspergillus niger* volume so that it decreased to zero in treatment C (cinnamon 3%) and treatment D (with surbathe); thus, there is a meaningful difference between control treatment and other ones ($p < 0.01$). also there is not any meaningful difference between treatments C and D due to high concentration of cinnofiline and cinnofelene oxide in cinnamon.

Results of this research are in accordance with that of Taleie et al (2008) expressing that a combination of medicine plants with cinnamon has anti-microbial effects on negative and positive hot bacteria. Also Akbariyan et al (2012) expressed that Tarune powder has the most effect on *Aspergillus niger* and *Aspergillus oryzae*. In another research, Sa'atchi et al (2008) studied anti-oxidant and antifungal effect of lemon balm and lavender which both have protective effects like cinnamon due to existence of hydrocarbon monoterpenes.

Impact of adding several levels of cinnamon (1 and 3 %) and surbathe on batter corruption with *Bacillus*

According to results of table (7), it is observed that use of cinnamon instead of wheat flour would decrease *Bacillus* volume so that it decreased to zero, but surbathe had not any effect on amount of *Bacillus* available in the batter; thus, there is a meaningful difference between control treatment and other ones ($p < 0.01$), but there is not any meaningful difference between treatments C and D due to existence of karokerole against cells *Bacillus* vegetative cells. Results of this research showed that cinnamon and cinnamon essence have the most anti-microbial activity against *Aspergillus niger* among positive hot bacteria.

Impact of adding several levels of cinnamon (1 and 3 %) and surbathe on batter corruption with *Ashershia*

According to results of table (7), it is observed that use of cinnamon instead of wheat flour would decrease *Ashershia* volume so that it decreased to zero, but surbathe had not any effect on amount of *Bacillus* available in the batter; thus, there is a meaningful difference between control treatment and other ones ($p < 0.01$), but there is not any meaningful difference between treatments C and D. Shan et al (2007) in a research expressed that hot positive *Acetabulo* bacteria are more sensitive to powders and spices such as cinnamon, oil essences,

and medicine plants. Hot negative bacteria are resistant to anti-microbial materials due to their Hydrophilic surfaces; these surfaces also are in contact with many lipo poly sakaride molecules that can analyze the outer layer molecules. Therefore, anti-microbial materials can pass cell wall and outer membrane damaging Cytoplasmic membrane and causing cytoplasm leak.

Impact of adding several levels of cinnamon (1 and 3 %) and surbathe on batter corruption with Acetafilo coce

according to results of table (7), it is observed that use of cinnamon instead of wheat flour would decrease Acetafilo coce volume so that it decreased to zero, but surbathe had not any effect on amount of Acetafilo coce; thus, there is a meaningful difference between control treatment and treatments B and C ($p < 0.01$), but there is not any meaningful difference between control treatment and treatment containing yurbathe ($p > 0.05$).

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